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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference HJFI20020465	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/FI 03/00174	International filing date (day/month/year) 07.03.2003	Priority date (day/month/year) 13.03.2002
International Patent Classification (IPC) or both national classification and IPC D21G1/00		
Applicant METSO PAPER, INC. et al.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 5 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>		
Date of submission of the demand  19.09.2003	Date of completion of this report  16.02.2004	
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Auer, H  Telephone No. +49 89 2399-2054 	

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI 03/00174

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

3-6 as originally filed  
1, 1a, 2, 2a received on 29.01.2004 with letter of 29.01.2004

**Claims, Numbers**

1-7 received on 29.01.2004 with letter of 29.01.2004

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
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International application No. **PCT/FI 03/00174**

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-7
	No: Claims	
Inventive step (IS)	Yes: Claims	1-7
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-7
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/FI03/00174

ad V:

1. Most relevant prior art document is JP-A-52121510, which is cited in the description and which discloses a nip roll of a paper machine which is manufactured of steel.

The problem of the invention is to provide a long nip calender roll that withstands the high thermal stresses caused by the long nip processes and enables an efficient heat transfer to paper.

The solution is given by the combination of features of claim 1, i.e. in particular by the properties of the roll such as defined in claim 1.

There is no hint in JP-A-52121510 for this solution nor in the other documents cited in the search report which disclose only technological background.

Claim 1 is, therefore, in line with Articles 33(2) and (3) PCT.

2. The subject-matter of the dependent claims contain further embodiments of the invention and is also in combination with the independent claims novel and inventive (Articles 33(2) and (3) PCT).

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Nip roll of a paper or board machine

- 5 The invention relates to a roll according to the preamble of claim 1.

←[insert page 1a]

Various calendering concepts are known from prior art, one of which is long nip calendering. Long nip calendering can be based on shoe press technology or on belt/roll technology. In shoe calendering, shoe press technology known from the press section is used and the shoe roll comprises a shoe, loading elements, a lubricating oil system and a belt. A thermo roll is used as the other roll of the calendering nip, which roll can be a water-, steam-, oil-, or induction-heated roll. A belt calender comprises a thermo roll, a belt loop and a backing roll, which may be either a hard or a soft roll, and the belt circulates over the backing roll and the guide/tension rolls. In the long nip calendering process large amounts of heat are transferred from the thermo roll to paper and the great heat amounts generate high thermal stresses and rapid stress gradients in the thermo roll, in which case the properties (durability) of the cast iron rolls used at present are no longer sufficient for the desired process conditions. In addition, the stress states in the roll during its use may vary in the direction of thickness of the material of the roll, to which the materials used today, e.g. chill casting, are poorly resistant.

In today's paper and board machines the calendering process is often connected as an on-line unit to a paper or board machine, in which case, e.g. the changing and cleaning of the roll have to take place quickly in order to avoid wasting valuable capacity. This is problematic, since, according to industrial safety regulations, the temperature of a hot roll must be under 60°C before it can be changed and, on the other hand, the working temperature of the roll is as high as 200°C. Prior art chilled rolls withstand a temperature change rate of 2°C/min., due to which a considerable amount of time and capacity has been lost in connection with the

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1a

JP-A-52121510 discloses a nip roll of a paper machine which is manufactured of  
5 steel.

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changing or cleaning of the roll. This has even partly led to the attempt to clean the rolls quickly, for example with a pressure washer, with the result that the roll cools down too quickly with respect to its strength, and thus serious damage may have been caused to the roll.

5

Rolls having a steel surface are also known from prior art - one example being disclosed in US patent 6,203,307. In the hot soft nip calender disclosed in the patent, rolls with a steel outer surface are used as calender rolls to be heated. In traditional soft calendering the heat amounts transferred are, however, considerably smaller than in long nip calendering.

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Arrangements in which the wear resistance of the steel roll has been provided by coating are known from prior art. Some such arrangements are disclosed in US patents 4,452,647 and 5,167,068.

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← [insert page 2a]

A very long nip, typically being over 30 mm, and high temperatures, the surface temperature of the roll typically being over 160°C (the interior of the roll can be even considerably hotter), and possibly moisturizing of the paper/board web with water or steam are needed in the long nip calendering process. These factors do not enable the manufacture of the machine, especially of the thermo roll of the nip, by means of the traditional technique, or, if manufactured traditionally, the machine has a low fault tolerance in case of a process failure.

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In modern paper and board machines rolls, particularly nip rolls, which withstand dramatic changes in the process conditions are needed, and it is an important object of the invention to provide such a roll.

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A special object of the invention is to provide a long nip calender roll that withstands the high thermal stresses caused by the long nip process and enables an efficient heat transfer to paper.

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2a

- With respect to prior art, reference is also made to US-A-5,334,125 and EP-A-369 968. US patent 5,334,125 discloses a martensite roll which has a cast-iron shell.
- 5 The surface layer of the roll shell is hardened and tempered such that the structure of the surface layer of the roll shell is martensitic. Published EP application 369 968 discloses an arrangement in a paper machine, in which the surface properties of a roll and/or rolls are affected by regulating the temperature of the roll surface by means of an external heating device. In the arrangement, such a combination of
- 10 a heating device and a roll coating is used that the heating radiation penetrates through the paper or only directly to the roll surface but does not heat the roll itself at a greater depth.

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**Amended Claims**

- 5 1. A nip roll of a paper or board machine, which roll is a heatable roll manufactured of steel, characterized in that the thermal shock resistance of the roll is over  $6000 \text{ W/m}^2$  and that the roll has good strength properties; tensile strength over  $1000 \text{ MPa}$  and a particularly high resistance against sudden thermal stresses, elongation at fracture over  $7 \%$  and dynamic ductility over  $20 \text{ J}$ , good wear resistance properties, surface hardness over  $400 \text{ HV}_{20}$ .
- 10 2. A roll according to claim 1, characterized in that the material of the roll is quenched and tempered steel.
3. A roll according to claim 1, characterized in that the surface of the roll has been hard coated to increase wear resistance.
- 15 4. A roll according to claim 1, characterized in that the surface of the roll has been heat treated, preferably induction hardened, to increase wear resistance.
- 20 5. A roll according to claim 3 or 4, characterized in that the tempering steel is at a basic hardness of about  $250 \text{ HV}_{20}$  or in the quenching and tempering at a hardness of over  $400 \text{ HV}_{20}$ .
- 25 6. A roll according to claim 1, characterized in that the shell of the roll comprises two or more different materials.
7. A roll according to claim 1, characterized in that the roll is a roll of a long nip calender.

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